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Financial Market Imperfection, Overinvestment, and Speculative Precaution

by

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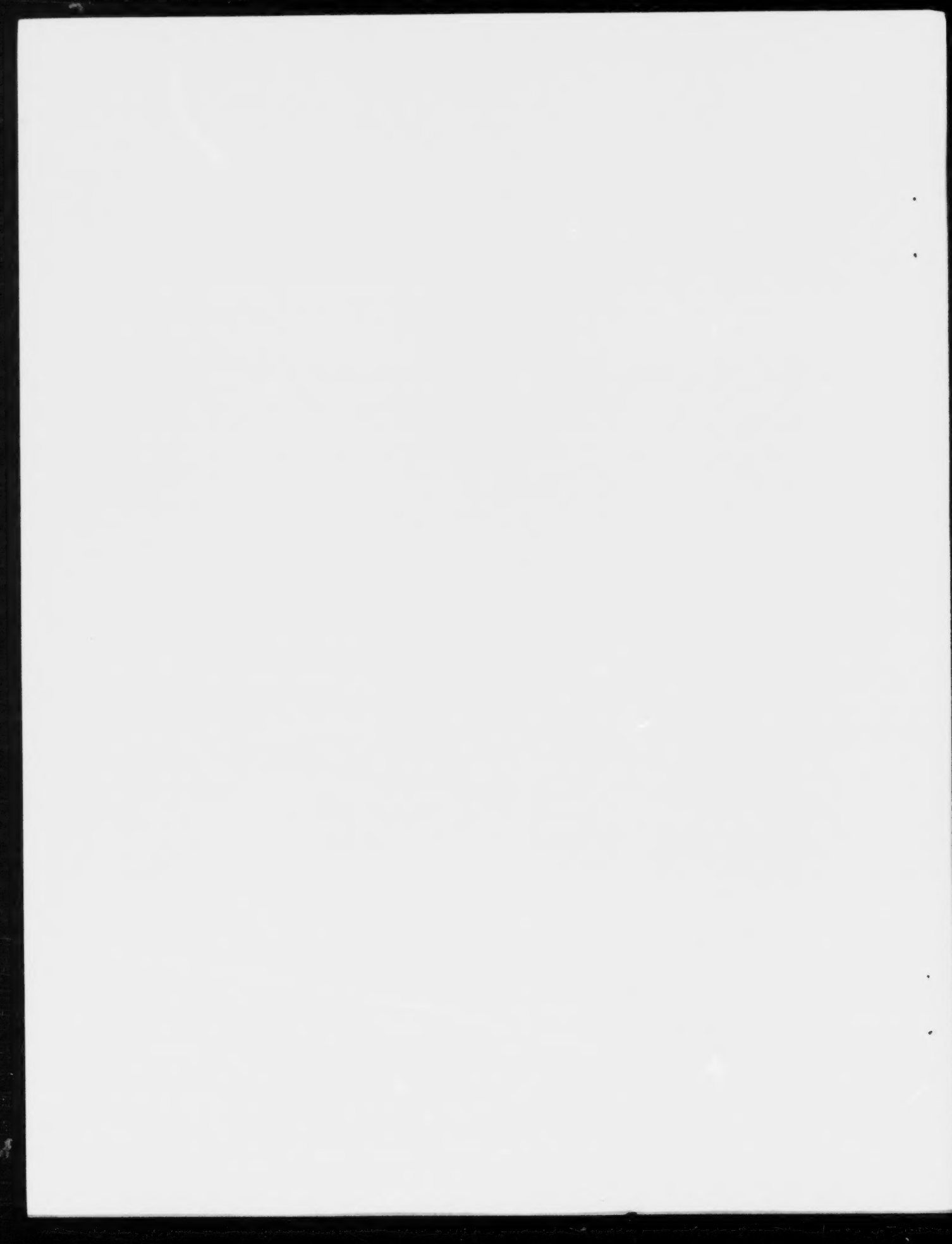
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The views expressed in this paper are those of the author.
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Abstract

The author uses panel data to assess the sensitivity of investment to cash flow in non-financial firms, taking into account the role their financial health plays in investment decisions. Firms are categorized using a method called the Z-score, a contemporaneous indicator of financial stress that is inversely related to firms' probability of financial failure. Based on this method, empirical evidence suggests that firms that have the greatest sensitivity of investment to cash flow display the lowest average Z-score. The author also shows that, in this class of firms, investment seems to be partly driven by excessive conservatism, or precaution.

JEL classification: D92, E22, E44, G33

Bank classification: Business fluctuations and cycles

Résumé

À l'aide de données de panel, l'auteur évalue la sensibilité de l'investissement des entreprises non financières à leurs flux de trésorerie en tenant compte du rôle que leur santé financière joue dans leurs décisions d'investissement. Les entreprises sont classées au moyen d'un indicateur contemporain du stress financier qui est inversement lié à la probabilité de défaillance financière des entreprises, appelé score Z. À l'aune de ce critère, les résultats empiriques donnent à penser que les entreprises dont l'investissement est le plus sensible aux flux de trésorerie présentent le plus faible score Z moyen. L'auteur montre également que, dans cette catégorie d'entreprises, l'investissement semble déterminé en partie par un conservatisme excessif ou par un motif de précaution.

Classification JEL : D92, E22, E44, G33

Classification de la Banque : Cycles et fluctuations économiques



"There is no necessity to hold idle cash to bridge over intervals if it can be obtained without difficulty at the moment when it is actually required."

J.M. Keynes (1936)

1 Introduction

The investment decisions of firms that have differing financial profiles can differ qualitatively (and quantitatively). The fact that, for some firms, investment is sensitive to variations in the level of internal funds or liquidity (e.g., cash flow) has been demonstrated repeatedly in the literature (Fazzari, Hubbard, and Petersen 1988; Whited 1992). Recent findings suggest that, for firms that are financially constrained, investment spending is sensitive to internal funds. They also emphasize the fact that these results depend crucially upon the method used to determine which firms are financially constrained and which are not (Kaplan and Zingales 1995, 2000).

In this paper, I use panel data¹ to assess the sensitivity of investment to cash flow for non-financial firms, taking into account the role their financial health plays in investment decisions. This paper's contribution to the literature is the method it uses to determine the degree of firms' financial health. The method is based on a contemporaneous measure of the firms' probability of experiencing financial stress (the Z-score²). Based on the Z-score, the empirical evidence suggests that the firms with investment that is most sensitive to cash flow have the lowest Z-score. The evidence also suggests that, in this class of firms, investment seems to be partly driven by precaution. While this last

¹The data are taken from Compustat. See Appendix B for a brief description of the data.

²The Z-score relates a firm's probability of bankruptcy to its working capital, total assets, earnings before interest and taxes, sales, and other financial variables. The Z-score does not rely directly on investment or cash flow, which permits its direct use in investment regressions. This score indicates the nature of the future financial constraints that a firm is expected to face. Obviously, the Z-score is not a perfect indicator. Numerous such indicators are available in the literature; the Z-score is the most commonly accepted and used measure. See section 4.1.

finding can be explained by financial market imperfections that stem from informational problems, another explanation is suggested by the risk-sharing nature of lender-borrower relationships.

Theoretically, an investment should be sensitive only to the profitability of the project with which it is associated. Usually, the classical approach relates investment to a measure of this profitability, such as Tobin's q . Empirical evidence, however, seems to suggest that investment is also related to some financial variables, such as cash flow. To account for this extrasensitivity, it is common to introduce some financial market imperfection, thereby departing from the classical framework. In the literature, asymmetric information models are often used to explain the sensitivity of investment to cash flow. These models support the view that investment by financially constrained firms has a greater sensitivity to cash flow. It is generally accepted that financial constraints that arise from informational problems or agency costs preclude some firms from reaching their desired (first-best) level of investment. Financially constrained firms are thus presumed to underinvest because internal funds are partially depleted and external funds are available only at a prohibitive price (or not at all).

The fact that investment is related not only to Tobin's q but is also sensitive to cash flow and other financial variables has recently been challenged. Using conventional methods of categorization (e.g., size, age, dividend-payout ratio), Whited and Erickson (2000) show that, when estimating investment with a strictly measured variable of expected profitability (as with Tobin's q), cash flow and other financial factors become insignificant. This is the case regardless of the financial situation of the firm. Similarly, Gomes (2001) shows that, when using a more refined measure of profitability (i.e., a variable that incorporates financial constraints), cash flow is no longer a significant explanatory variable for investment. Nevertheless, as Whited and Erickson (2000) state, this does not necessarily rule out the idea that investment might also be partly driven by financial considerations. Instead, it means that the measure of the firm's profitability could incorporate the influ-

ence of financial factors, leading to a non-significant role for those factors in explaining investment.

The approach of Whited and Erikson (2000) or Gomes (2001) is convenient for characterizing the determinants of investment. It is less appropriate, however, for identifying the role of firms' financial health in investment decisions. Indeed, a purely empirical measure of expected profitability should incorporate financial constraints as one of its components, but such a measure would not necessarily be tractable for studying the effect of financial variables on investment. Hence, in this paper, I use a pseudo-measure of a firm's profitability; i.e., Tobin's q , the conventional measure of profitability. The aim of this work is to identify the role of intertemporal financing for investment, by showing how overinvestment is linked to what Kaplan and Zingales (1995, 2000) call "excessive conservatism," or precaution. Section 2 discusses the conventional approach used to emphasize the sensitivity of investment to cash flow among different types of firms. It also describes the different methods used to categorize firms as either financially constrained or healthy. Section 3 describes evidence of firms' excessive conservatism. Section 4 proposes an alternative indicator of financial stress, called the Z-score, that helps to explain the excessive conservatism identified in previous studies. Since the Z-score is based on expectations about the financial conditions that firms will face, it uses a risk-sharing argument to interpret the sensitivity of investment to cash flow. Section 5 concludes and describes some macroeconomic implications of the results.

2 A Brief Overview of the Literature

2.1 Financial market imperfections

According to asymmetric information models, some firms that expect future financial stress cannot necessarily borrow more in advance if they are already constrained. Yet,

one might think that these firms could still hold cash to cushion any severe future constraint: cash flow would be held as a precautionary buffer, as Schnure (1998) suggests. The lender might agree with this precaution, because it could provide some financial protection to the borrower (Sigouin 2003) and therefore to the long-term relationship between the two parties. This feature is not taken fully into account by the asymmetric information framework. Furthermore, a firm that is not financially constrained but expects to be restricted in the near future would be willing to increase its borrowing in the short run, before being restricted. Regarding precaution, firms could possibly want to *increase* their investment/borrowing level before facing a severe borrowing limit, rather than underinvest, as the asymmetric information framework assumes.

An alternative approach emphasizes the role of risk-sharing and limited commitment between the financial intermediary and the firm. Marcet and Marimon (1992) show that the limited-commitment framework has more pervasive effects on investment spending than the framework for asymmetric information. The limited-commitment approach assumes that the financial relationship between a borrower and a creditor can be unilaterally terminated at any time (Kehoe and Levine 1993). Consequently, when there is risk-sharing, endogenous financing constraints that arise from limited commitment can potentially lead to *overinvestment* as well as underinvestment.

This property arises in some limited-commitment models, but not all. For example, this is not the case in Hart and Moore (1994) or in Albuquerque and Hopenhayn (1997). In their models, investment takes place in only the first period. Kiyotaki and Moore (1997) and Hart and Moore (1994) base their research on anonymous debt contracts and do not allow for long-term relationships. Sigouin (2003), however, shows that, in a limited-commitment model where investment decisions occur each period, and where the relationship lasts *ad infinitum*, a self-enforcing financial contract can arise endogenously. Because the model assumes a stochastic environment (in contrast to Kiyotaki and Moore 1997, and Hart and Moore 1994), it is possible to evaluate the impact of "unexpected but

rationality anticipated" fluctuations in the availability of internal funds. Sigouin's major finding is that an entrepreneur can, in fact, overborrow at the end of economic upturns, to take advantage of the still-low cost of external funds.

2.2 The sensitivity of investment to cash flow

Regardless of the type of market imperfection considered (e.g., informational problems or limited-commitment), the usual result in the literature is some sensitivity of investment to cash flow, and the sensitivity seems more pronounced for financially constrained firms. This is an indirect indication of some form of market imperfection.

Fazzari, Hubbard, and Petersen (1988) show that the financial structure of firms does matter for investment decisions. For some firms, external funds do not provide a perfect substitute for internal capital. The authors show that the conventional representative-firm approach might apply to mature companies, but that financial factors play an important role for other firms. Using Value Line data for 421 manufacturing firms, Fazzari, Hubbard, and Petersen analyze differences in investment among firms with a sample categorized according to the dividend-income ratio as a proxy for earnings-retention practices. This criterion is relevant because retained earnings are the main source of internal finance and net funds regardless of firm size. The retention ratio decreases monotonically with asset size, from 80 per cent for small firms to 50 per cent for large firms. Fazzari, Hubbard, and Petersen use the following reduced-form investment equations:

$$(I/K)_{i,t} = f(X/K)_{i,t} + g(CF/K)_{i,t} + u_{i,t},$$

where i = firm class, I = investment in plant and equipment, K = beginning-of-period capital stock, X = the vector of variables controlling for investment opportunities, and CF = cash flow.

Fazzari, Hubbard, and Petersen find that investment by firms with a low dividend-income ratio is sensitive to fluctuations in cash flow. Although firms with a low dividend-

income ratio are smaller on average, this does not mean that firm size is always a factor. When the firms are categorized according to size (average capital stock), the authors find that small firms have a relatively low cash flow coefficient. Furthermore, the cash flow effect holds for every class of dividend-income ratio; however, the cash flow effect is strongest for the lowest dividend-income ratio class.

Fazzari, Hubbard, and Petersen conclude that financial factors play a role in investment decisions, especially for financially constrained firms (identified as the low dividend-income firms). This conclusion is quite robust: it supports both the limited-commitment and the asymmetric information approaches, because it provides empirical evidence of the sensitivity of investment to cash flow. This empirical evidence is repeatedly confirmed in the literature. For example, Mills, Morling, and Tease (1995) find similar evidence regarding financial factor effects on investment. Using different methods of categorization, they find that investment by small firms, particularly by highly leveraged firms and firms with high retention ratios, is highly sensitive to cash flow. Mills, Morling, and Tease estimate:

$$I_{i,t}/K_{i,t-1} = \alpha + \beta_1 q_{i,t-1} + \beta_2 (CF_{i,t}/K_{i,t-1}) + \beta_3 (L_{i,t-1}/K_{i,t-2}) + \beta_4 (D_{i,t-1}/K_{i,t-2}) + \beta_5 (S_{i,t}/K_{i,t-1}),$$

where q = the conventional Tobin's q , L = the stock of liquid financial assets, D = the stock of outstanding debt, and S = sales (the last three being measured at the end of the previous period).

One might attribute these results to the fact that the proxy variable constructed for Tobin's q does not completely capture investment opportunities, making cash flow spuriously significant. Yet Fazzari, Hubbard, and Petersen (1988) attempt to control for that problem, as do Gilchrist and Himmelberg (1995, 1998). Following Abel and Blanchard (1986), Gilchrist and Himmelberg (1995) estimate a set of vector autoregressive forecasting equations to build a proxy for the expected value of marginal q conditional on observed fundamentals: a "fundamental q ." This allows the role of cash flow as a forecasting variable to be distinguished from its role as an explanatory variable of investment.

Even when controlling for this, the empirical evidence of Fazzari, Hubbard, and Petersen still holds true. Using Compustat data, Gilchrist and Himmelberg (1995) confirm that financial factors matter for all firms and that the sensitivity of investment to cash flow is strong for firms identified as being financially constrained, although the fundamental q is strongly significant for unconstrained firms. For financially constrained firms, the use of the fundamental q seems superfluous, since the sensitivity of investment to cash flow is almost the same as when using more conventional measures of q . Actually, the use of conventional measures of q underestimates the different sensitivity of investment to cash flow among classes of firms.

When they use the same method as Fazzari, Hubbard, and Petersen (1988) to identify financially constrained firms (the dividend-payout ratio), Gilchrist and Himmelberg (1995) find contradicting results. This suggests that both the method of categorization and the firm's method of measuring its profitability matter. When considering firm size, CP ratings, and bond ratings, the majority of these criteria reveal the sensitivity of investment to cash flow for financially constrained firms. Consequently, Gilchrist and Himmelberg infer that the empirical evidence supports the asymmetric information approach.

3 Excessive Conservatism, and Precaution

The sensitivity of investment to cash flow that financially constrained firms experience can be linked to the asymmetric information framework as well as the limited-commitment one. But some limited-commitment models cause financially constrained firms to overinvest, in anticipation of further constraints, which leads to a different explanation of investment sensitivity. Puzzling empirical evidence suggests that some firms whose investment is sensitive to cash flow actually *smooth* their investment.

The first significant finding is that, in some studies, cash flow matters, but in a non-linear manner. Fazzari, Hubbard, and Petersen (1988), and Devereux and Schiantarelli

(1989) show that the timing of the cash flow effect is more complex than suggested by the asymmetric information framework. As Devereux and Schiantarelli state, the asymmetric information models "do not yield an investment equation that explains how financial factors and *expectations* about firm's prospects jointly determine investment." In addition to reporting the fact that the cash flow *dynamic* effect is not captured, Devereux and Schiantarelli assert that cash flow fluctuations might play a role for all firms, and not just those with currently depleted internal funds or an incapacity to issue new shares. Categorizing firms according to size, they show that the sensitivity of investment to cash flow is actually greater for large firms.

Kaplan and Zingales (1995, 2000) also cast doubt on a monotonic relationship between the sensitivity of investment to cash flow and the firm's category. They find that the less financially constrained firms can actually hold more internal funds and exhibit a significantly higher sensitivity of investment to cash flow. One possible explanation Kaplan and Zingales give for the low sensitivity of investment by financially constrained firms relies on capital adjustment costs. When a financially constrained firm experiences a jump in cash flow, it invests more. But because capital adjustment costs force the firm to invest prior to the increase in liquidity, the investment reaction is dampened. If the firm had not been constrained during a downturn, it would have invested more. In addition, if firms with very scarce cash flow are included in the analysis, then it is obviously possible to find that the sensitivity of their investment is unrelated to cash flow, because of their extreme financial distress.

To categorize firms according to their relative degree of financing constraints, Kaplan and Zingales (1995) use qualitative information from annual reports, as well as quantitative information about the firms' financial statements and notes retrieved from Compustat. Because their results contradict previous studies, Kaplan and Zingales conclude that the observed sensitivity of investment to cash flow depends crucially on the method of categorization used. The relationship is not necessarily monotonic, since unconstrained

firms can also be sensitive to cash flow depending on the criterion used. Kaplan and Zingales insist that their paradoxical results should command criticism when the influence of financial factors is examined. If the least-constrained firms are in fact somehow intertemporally constrained, then the method of categorization must be designed accordingly. This also suggests that designing a method that is truly able to categorize firms according to their current and expected degree of financial constraint, as Kaplan and Zingales show, is useful for determining the degree of non-linearity in the sensitivity of investment to cash flow.

With respect to the two issues described above, Fazzari, Hubbard, and Petersen (1988) explain that firms with large amounts of cash balances and unused lines of credit may be *expecting* future financial constraints. This coincides with the view of Kaplan and Zingales (2000) regarding the excessive conservatism of managers. Gertler and Gilchrist (1993) state that bank lending to large firms *rises* following tight monetary policy. They interpret this as evidence of smoothing behaviour: large firms borrow more to cushion themselves from expected declines in sales revenue in the wake of tighter monetary conditions. Empirical evidence shows that there is a slightly positive response from business loans, lasting almost one year, after an interest rate increase (Bernanke, Gertler, and Gilchrist 1996). Thurlow (1994), conducting a vector autoregression (VAR) analysis, shows that the immediate response to monetary tightening is an increase in lending and inventory stocks, a result consistent with the findings of Gertler and Gilchrist (1994). This response could result from the fact that lenders are willing to provide more funds in an effort to prevent premature bankruptcies, an intertemporal interpretation consistent with limited-commitment models à la Thomas and Worrall.³

Gertler and Gilchrist (1994) state that overinvestment by large firms seems to be a

³In VAR studies, the trough in output generally precedes that in business credit, and the increased demand for business credit coincides with a rise in inventories. I thank Scott Hendry for pointing out these facts.

result of persistently piling up inventories at the onset of monetary policy tightenings (for Romer dates, see Romer and Romer 1988, 1992). The view of a desired inventory buildup for precautionary reasons vis-à-vis expected credit limitations is also advocated by Thurlow (1994). He notes that an undesired inventory buildup due to real rigidities is not supported by the facts, does not explain the increase in sales prior to a downturn, and does not generate asymmetric responses.⁴

If, for some firms, investment is sensitive to expected cash flow, then, when such firms anticipate lower future inflows, they should hold higher internal funds in advance whenever it is possible to do so. When a firm is so severely constrained that it cannot borrow but experiences scarce cash flow, it might use internal funds to smooth investment. The fact that future inflows might explain current cash flow positions is supported by the evidence of Opler et al. (1999). Net working capital is a proxy for money expected to be received by the firm within the year. Opler et al. (1999) present evidence that net working capital is negatively related to cash flow. Firms have target levels for cash flow, estimating

$$\Delta(CF/A)_t = \alpha + \beta\Delta(CF/A)_{t-1} + \epsilon_t,$$

where A = assets. Using Compustat data, Opler et al. (1999) find cash flow to be mean reverting. Firms try to stabilize their cash flow around a target value, with the average holdings being greater in volatile industries. They also find that the short-run impact of cash flow on investment is small. These findings suggest that cash flow helps a firm to continue its investment projects: a firm that has excess cash in one year will experience a fall in operating cash flow the next year. When a firm expects to be financially constrained, it accumulates cash to be able to finance investment despite the expected decrease in future cash flow. Opler et al. argue that this evidence is consistent with a dominant precautionary demand for liquid assets. While the results confirm that investment and cash flow are

⁴To account for this increasing investment, Thurlow (1994) assumes the existence of credit lines and time-consuming reorganization of credit by commercial banks. The limited-commitment approach offers a different explanation by making the creditor actually willing to increase lending.

dynamically related, the authors find no evidence that informational problems or agency costs would have an impact on a firm's propensity to spend excess cash.

In fact, the most important finding is that excess cash seems to be held in advance to cushion decreases in operative cash flows. This might be paralleled with overborrowing and increased investment in inventory stocks prior to downturns. In Opler et al., the propensity to use excess cash for capital expenditures is far from significant. As such, cash hoarding could be the result of risk aversion; i.e., a cash-in-advance motive driven by a form of liquidity preference.

The idea of treating cash flow as an independent variable to disentangle its effect on investment is also pursued by Schnure (1998), with the same conclusions. He develops a model of a firm's decision regarding cash flow given a probability of being credit-constrained in the future. Using Compustat data, Schnure suggests that informational problems or agency costs do not concern the majority of firms. He advocates precautionary cash balances regardless of a firm's size⁵ (in the United States, holders of high cash flow operate in the riskiest sectors, precisely where precaution matters). Whereas investment is positively correlated to past cash flow (Fazzari, Hubbard, and Petersen 1988; Devereux and Schiantarelli 1989), Schnure finds that current cash flow is strongly negatively related to future capital expenditures, especially for holders of high cash flow. This is consistent with the findings of Opler et al. (1999).

4 Categorizing Firms with their Z-Score

This paper uses panel data to assess the sensitivity of investment to cash flow in non-financial firms, taking into account the role their financial health plays in investment decisions. The firms are categorized using a measure called the Z-score; it is a contemporaneous indicator of financial stress that is inversely related to firms' probability of

⁵In the case of the most-liquid firms, cash comes from stock issuance.

financial failure. Like any method of categorization (e.g., dividend-payout ratio), the Z-score is unable to establish a definite link between the sensitivity of investment and cash flow, and it does not help distinguish between the demand and supply aspects of cash flow—although we are more interested in the demand aspects. It is precisely for these reasons that it is useful to investigate alternative methods of categorization. I choose the Z-score for its forward-looking nature, which makes it possible to investigate how precautionary motives relate to investment.

4.1 Average investment, inventories, cash flow, and sales

The first experiment computes average investment, inventories, cash flow, and sales, taking into account the financial situation of firms. Using Research Insight data⁶ from 1980 to 1998, I retrieve yearly financial data for over 16,000 firms. After cleaning the data set and transforming the variables, I compute the average ratios of investment, inventories, cash flow, and sales to total assets for a subsample of 2,999 firms. I exclude firms started after 1980, and firms for which these variables were not jointly available for at least fifteen consecutive years.

To account for excessive conservatism, I use the Z-score as the method of categorization. The Z-score relates the probability of a firm's bankruptcy to its working capital, total assets, earnings before interest and taxes, sales, and other financial variables.⁷ Hence, by construction, the Z-score does not rely directly on investment or cash flow, which permits its direct use in investment regressions.⁸ Numerous prediction models for financial stress are available in the literature (e.g., Theodossiou 1993), but it is beyond the scope of this paper to construct a variable for financial stress. Since Research Insight provides such

⁶Research Insight is a product of Standard and Poor's, similar to Compustat. The main difference is that Research Insight includes not only a data set but also software that enables data retrieval.

⁷For more details on the rigorous computation of the Z-score, see Altman, Haldeman, and Narayanan (1977), and Altman (1983).

⁸Regarding identification problems, the Z-score is still not perfect.

a variable for each firm in the sample, it is used directly in the regressions. Altman's Z-score indicates the future financial constraints that a firm is expected to face. In that respect, it provides an appropriate criterion by which to investigate whether precautionary investment exists in firms that are expecting financial troubles, regardless of their size, age, dividend-payout ratio, or rating.

In the first experiment, firms are assigned to one of three categories. When, for a specific year, a firm has a Z-score below 1.81, the threshold identified in Altman, Haldeman, and Narayanan (1977), it is categorized as a troubled firm with a high probability of bankruptcy. Above this threshold, the firm is categorized as a healthy firm with a low probability of bankruptcy. The third category is for firms that go bankrupt during the period.⁹

The computation of the ratios for the three categories reveals that firms with a high Z-score for a given year have relatively higher average ratios of cash flow, sales, and inventories than their troubled or bankrupt counterparts. The inventory ratio differential between bankrupt and healthy firms, however, seems smaller than that between troubled and healthy firms. This seems to also be the case for the cash flow ratio differential. More importantly, the average ratio of investment to total assets for each category indicates that firms with a high probability of bankruptcy in a given year do not necessarily invest less than firms in the healthy set (see Appendix A). In fact, between 1980 and 1989, and after 1997, the reverse holds true. The case appears even stronger for bankrupt firms.

These descriptive, albeit simple, statistics support the idea that there may be a case for excessive conservatism, or precaution, when troubled firms invest. These statistics are also consistent with the more conventional idea that troubled firms are financially stressed because of this overinvestment pattern. Nevertheless, assessing investment behaviour

⁹The threshold identified by Altman, Haldeman, and Narayanan (1977) is only a substitute for the threshold that could have been associated with the data set. However, estimating a new measure of the Z-score is beyond the scope of this study.

by considering the indicator of financial stress, such as the probability of bankruptcy embedded in the Z-score, could yield encouraging results.

4.2 Hoarding of cash flow

Schnure (1998) and Opler et al. (1999) describe cash flow hoarding behaviour. They relate this behaviour to the financial constraints that firms face. The common argument is that cash flow helps firms continue their investment projects. To illustrate this argument, I run several experiments involving cash flow, categorizing firms according to their average Z-score throughout the 1980–1998 period. This categorization is ad hoc, in that its only objective is to show how the behaviour of firms evolves, depending on their average Z-score. In the experiments, I estimate cash flow equations using regressors that are similar to those of Schnure (1998) and Opler et al. (1999). The primary objective is to check for the hoarding of cash flow. In the first experiment, I use seven categories for firms, ranging from an average Z-score of 1.5 to an average of 5. Each category corresponds to an increment of 0.5 in the average Z-score. When I regress cash flow on past cash flow, investment, and debt, and adjust for firms clustering, the overall fit is significant ($Wald\ chi^2(3) = 1005.18$, $Prob > \chi^2 = 0.000$). Apart from the constant ($z = -31.37$), the most significant regressor is past cash flow ($z = 17.26$), as expected. As with Schnure (1998) and Opler et al. (1999), I find that past cash flow is always a strongly significant regressor, regardless of the firm class (see Table 1). Firms seem to display a hoarding behaviour that is consistent with the excessive conservatism argument of Kaplan and Zingales (1995, 2000) and Devereux and Schiantarelli (1989). Furthermore, in the model, investment has a strong positive coefficient and debt has a negative coefficient. If firms are hoarding cash flow to continue their investment projects, their ability to do so is impacted negatively by their debt level: the higher the debt level, the harder it is for firms to maintain their buffer. When the regression is run on subsamples of firms, the result is the same. In low average Z-score firms, however, debt is relatively less significant,

Table 1: Hoarding of Cash Flow (dependent variable: cash flow/total asset)

Z-score	Lagged cash flow	Investment	Debt	Constant
All firms	0.319	1.5	-0.942	-1.498
9,047 firms	(0.000)	(0.000)	(0.000)	(0.000)
[1.5,2]	0.307	1.677	-0.288	-1.814
603 firms	(0.000)	(0.000)	(0.277)	(0.000)
[2.2,5]	0.276	1.915	-0.662	-1.783
703 firms	(0.000)	(0.001)	(0.001)	(0.000)
[2.5,3]	0.331	1.315	-0.702	-1.56
833 firms	(0.000)	(0.046)	(0.000)	(0.000)
[3.3,5]	0.306	1.545	-0.737	-1.628
1,223 firms	(0.000)	(0.001)	(0.000)	(0.000)
[3.5,4]	0.255	3.43	-0.550	-1.924
1,057 firms	(0.000)	(0.000)	(0.047)	(0.000)
[4.4,5]	0.404	1.661	-0.678	-1.320
857 firms	(0.000)	(0.000)	(0.005)	(0.000)
[4.5,5]	0.449	1.651	-0.504	-1.222
730 firms	(0.000)	(0.000)	(0.004)	(0.000)

Z-score = average Z-score, Cash flow = $\log(\text{cash flow}/(\text{total asset}-\text{cash flow}))$, Investment = (capital expenditures/total asset), Debt = total debt/total asset
(*P*-values in parentheses)

which reinforces the explanatory power of lagged cash flow (and investment). Investment is usually the most volatile regressor, and lagged cash flow is always significant. All categories display a significant fit, and the coefficient on cash flow and other variables does not change much, as the Chow tests suggest.

Schnure (1998) states that net working capital should be a significant and negative regressor of cash flow changes, since it is a proxy for the expected liquid inflows. Because the description in many studies of a mean reverting property of cash flow is consistent with the idea of excessive conservatism, cash flow levels would tend to be maintained through time. To confirm this view, I run a second experiment, regressing differenced cash flow on its lag and net working capital, and again adjusting for firms clustering. This specification fits the data reasonably well ($Wald\ Chi2 = 30.65$, $Prob > Chi2 = 0.000$) and all variables are significant. As expected, net working capital has a negative coefficient (see Table 2). It is also the most significant regressor ($z = -6.97$, compared with -3.02 for past differenced cash flow, and 3.81 for the constant). The mean reversion of cash flow is captured by the negative sign of past differenced cash flow, and this variable displays a strong coefficient. When I run the regression on two subsamples of firms, those with a low average Z-score $[1.5, 2]$ and those with a higher average Z-score $[2, 20]$, the model remains significant and Chow tests suggest no significant difference in the coefficients. Low Z-score firms, however, seem to display a relatively greater significance in net working capital. Higher Z-score firms would have a stronger past differenced cash flow coefficient, which could be explained by their better *ability* to preserve their cash reserves.

The result for net working capital can also be obtained by regressing cash flow on lagged cash flow, debt, and net working capital. This specification is not rejected ($Wald\ Chi2 = 71.19$, $Prob > Chi2 = 0.000$) and all the coefficients are significant (Table 3). In this model, net working capital is the most significant variable ($z = -6.68$, compared with 5.31 for lagged cash flow and -4.21 for debt) with the constant ($z = 10.18$). It also has the expected negative sign, as debt. Lagged cash flow has a strong coefficient regardless

Table 2: Net Working Capital versus Past Cash Flow (dependent variable: change in cash flow)

Z-score	Lagged cash flow	Net working capital	Constant
All firms	-0.231	-0.0001	0.0046
10,008 firms	(0.003)	(0.000)	(0.000)
[1.5,2]	-0.181	-0.0002	-0.003
720 firms	(0.104)	(0.000)	(0.0236)
[2,20]	-0.374	-0.0001	0.008
8,115 firms	(0.000)	(0.000)	(0.000)

Cash flow = (cash flow/total asset) - (previous cash flow/previous total asset), Net working capital = working capital - cash flow

Table 3: Cash Flow Hoarding and Debt (dependent variable: cash flow)

Z-score	Lagged cash flow	Debt	Net working capital	Constant
All firms	0.320	-0.166	-0.0002	0.089
10,164 firms	(0.000)	(0.000)	(0.000)	(0.000)
[1.5,2.5]	0.243	-0.240	-0.0003	0.117
1,624 firms	(0.000)	(0.048)	(0.000)	(0.004)
[2.5,3.5]	0.164	-0.121	-0.0005	0.102
2,321 firms	(0.000)	(0.000)	(0.000)	(0.000)
[3.5,5]	0.296	-0.084	-0.0002	0.082
2,773 firms	(0.001)	(0.002)	(0.000)	(0.000)

Cash flow = cash flow/total asset

of its categorization, and Chow tests suggest that this coefficient does not change much across firms. As before, the explanatory power of lagged cash flow seems greater for low Z-score firms, and debt less so.

Although Schumre's results can be reproduced using my method of categorizing firms, the robustness of his results might be improved upon by using a better-tailored method, particularly one that does not rely on the working capital variable for that specific study. Because my purpose in this paper is to study the precautionary part of investment, the use of alternative indicators of financial stress is left for future research. Note also that, in most experiments, the coefficients do not significantly change across categories of firms. For example, hoarding of cash flow is a phenomenon common to all firms, because among other reasons, the method of categorization captures the *average* Z-score. Hence, in my experiments, a low Z-score firm is financially troubled on average, and not necessarily often constrained; the Z-score is quite a volatile series.

4.3 Investment and financial expectations

To further assess the "excessive conservatism" argument, it is possible to use the mode of the Z-score in conjunction with my method of categorizing firms. In the following experiments, I assign firms to one of two categories (the low Z-score class and the high Z-score class), depending on their average Z-score *and* the modes of their Z-score. The minimum mode of the Z-score across the 10,435 firms has a mean of 1.554 and a standard deviation of 5.054. The mean of the maximum mode is 7.2 (with a standard deviation of 9.7). The category for the financially constrained firms (the low Z-score class) excludes firms with a Z-score greater than 1.81 on average and a minimum mode that exceeds -3.5. The category for healthy firms (the high Z-score class) includes firms with a Z-score greater than 4 on average and a maximum mode that exceeds 17.

In the first experiment, I regress investment (capital expenditures) on a proxy for a firm's profitability (q), cash flow, sales, and inventories, controlling for fixed effects for the

Table 4: Sensitivity of Investment to Cash Flow (dependent variable: Investment)

Z-score	q	Cash flow	Sales	Inventories	Constant
All firms	0.011	0.007	0.004	0.005	0.170
10,186 firms	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Low Z-score	0.01	-0.044	0.009	-0.005	0.084
296 firms	(0.000)	(0.000)	(0.000)	(0.687)	(0.011)
High Z-score	-0.004	0.062	-0.003	0.046	0.042
459 firms	(0.007)	(0.000)	(0.217)	(0.007)	(0.338)

entire sample. The R^2 is 0.396 (0.4 within and 0.281 between) and q displays the strongest significance ($t = 39.11$, compared with 36.93 for the constant). More importantly, the cash flow is significant ($t = 3.21$), consistent with the findings of Fazzari, Hubbard, and Petersen (1988), and it suggests a relationship between investment and financial variables. Table 4 reports results from an experiment run on two subsamples of firms (the low Z-score class and the high Z-score class). The model is the same: $R^2 = 0.492$ (0.503 within and 0.439 between) and $Wald\ Chi2 = 704.44$ ($Prob > Chi2 = 0.000$). Inventories are not significant for the low Z-score class, and neither are sales for the high Z-score class. In both cases, q and cash flow are significant. Cash flow seems to act as a significant substitute for investment in the low Z-score category¹⁰ (i.e., the most severely constrained firms), and it is the most significant explanatory variable in the high Z-score class: $|z| = 5.54$, compared with 2.69 for q . Chow tests reveal that the two categories behave quite distinctively, with $Chi2(1) = 43.82$, $Prob > Chi2 = 0.000$ for cash flow and $Chi2(1) = 23.72$, $Prob > Chi2 = 0.000$ for q (inventories and sales display different coefficients also: $Prob > Chi2 = 0.08$ and $Prob > Chi2 = 0.002$, respectively). In the next experiment, I proxy overinvestment with the difference between a firm's investment

¹⁰This corroborates the precautionary motive illustrated in Tables 2 and 3.

Table 5: Overinvestment and Financial Health (dependent variable: overinvestment)

Z-score	Sales	q	$prob$
Low Z-score	0.006	0.006	0.015
296 firms	(0.043)	(0.027)	(0.022)
High Z-score	-0.001	-0.001	0.399
459 firms	(0.59)	(0.607)	(0.539)

and the average investment of its class (its Z-score category). I construct a dummy variable, $prob$, equal to unity if the Z-score is below the threshold of 1.81 (i.e., the firm faces a strong average probability of bankruptcy), and zero otherwise. There appears to exist more underinvesting firms (i.e., negative overinvestment) than overinvesting ones, so that $prob$ has a negative coefficient unless underinvesting firms are discarded. The regression of (positive) overinvestment on sales, q and $prob$, has a reasonable fit for the 302 observations ($Wald\ Chi2(6) = 137.81$, $Prob > Chi2 = 0.000$). As expected, removing any firm that has negative overinvestment delivers a positive coefficient of $prob$ for low Z-score firms (Table 5). $Prob$ is also found significant for this class. This is not true of any regressor for the high Z-score firms, possibly because overinvestment is less frequent in this category.

These results are only a preliminary indication of speculative overinvestment. The Chow tests reveal no significant difference in the coefficients of the two categories, which suggests that speculative overinvestment is still common among all firms, and (or) that it is a short-lived phenomenon that is hard to capture even with average Z-scores refined with Z modes. Furthermore, my method of categorizing firms might lead to a biased result, because it is somewhat related to the $prob$ regressor. In light of these caveats, it seems that financial factors are significant variables for investment, at least when they are isolated from the profitability variable. But the investment-cash flow relationship should not

necessarily be considered as only intratemporal. Indeed, the evidence suggests that any categorization method used to assess the sensitivity of investment to cash flow should take into account a firm's expected financial constraints. This would be addressed by a method based on the Z-score, as in this study, or by any similar financial stress indicator. This kind of "forward-looking" method makes it possible to investigate excessive conservatism, or precaution, for investment.

5 Conclusion: Some Macroeconomic Implications

According to asymmetric information models, the sensitivity of investment to cash flow leads to an internal propagation mechanism. When there is an upturn in the economy, external funds can be acquired at a cheaper cost. Indeed, an increase in internal funds, *ceteris paribus*, reduces the cost of borrowing. Financially constrained firms can then increase investment both because of the increase in internal funds and because external funds become less expensive. Their investment decisions are sensitive to variations in internal funds. This phenomenon is believed to generate a financial accelerator (Gertler and Gilchrist 1994). Gertler (1992) and Carlstrom and Fuerst (1997) argue that business fluctuations are amplified by the countercyclicality of external funds costs. During upturns, financially constrained firms have access to external funds at low cost. As their net worth increases, they invest more. This, in turn, triggers a further increase in output.

Some form of limited commitment makes investment and borrowing sensitive to expected variations in cash flows. This leads, however, to a financial decelerator consistent with the "excessive conservatism" argument. Therefore, in downturns, a firm can invest more than an asymmetric framework would predict, because risk-sharing fully plays its role; the precaution strongly prevails. The intuition behind this is straightforward. In asymmetric information models, financially constrained firms can decrease their degree of underinvestment only during upturns in the economy, whereas, in some limited-

commitment models, the financial constraint does not bind all the time. It arises (endogenously) only during downturns. Thus, depending on the contract design, a firm that expects a decrease in its future internal funds may have the opportunity to overinvest before facing the financial constraint vis-à-vis its creditor. This corresponds to the investment smoothing reported in this paper.

I have categorized firms using a method that roughly captures the forward-looking nature of investment decisions, beyond what can be achieved using a profitability variable. As long as this method is independent of q , it is possible to demonstrate excessive conservatism, or precaution, that leads directly to a financial decelerator. Sigouin (2003) explains this financial decelerator by relying on limited-commitment, self-enforcing contracts and risk-sharing between a borrower and a lender.

Because firms with high cash flow and high inventory levels do not need to invest under unfavourable circumstances—or, if so, can rely on internal financing—they are temporarily immune to an easing in credit conditions. Consistent with the interpretation of the investment-cash flow relation given above, Kaplan and Zingales (1995) further argue that “policies designed to make credit more available in recessions will not lead to increased investment by firms with the highest investment-cash flow sensitivity.”

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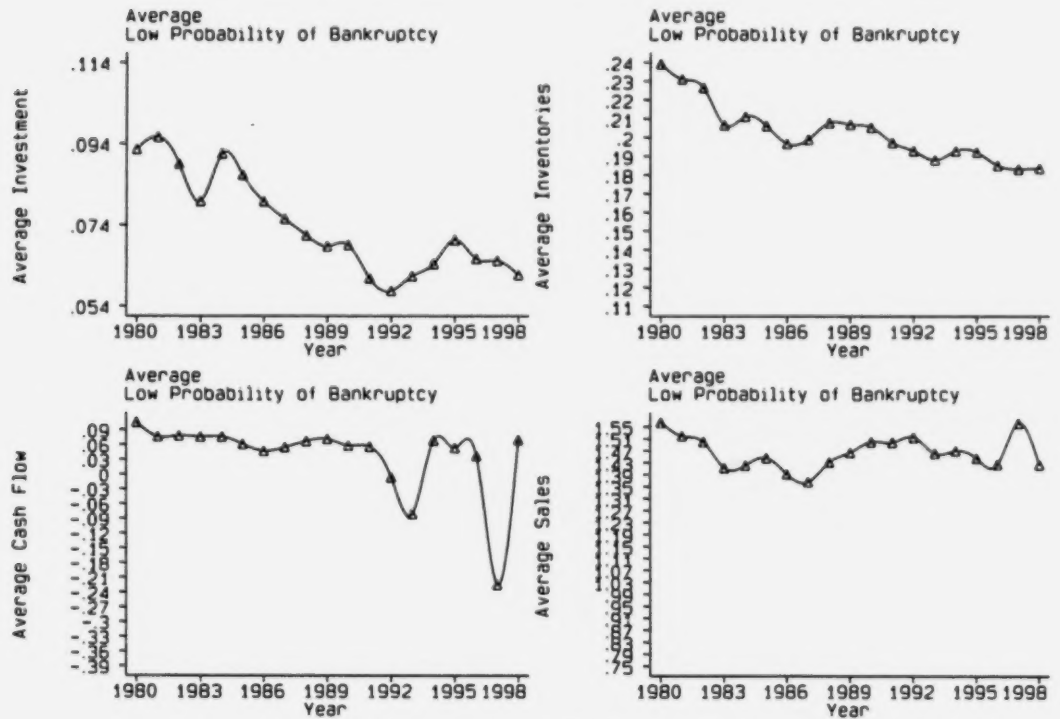
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Appendix A

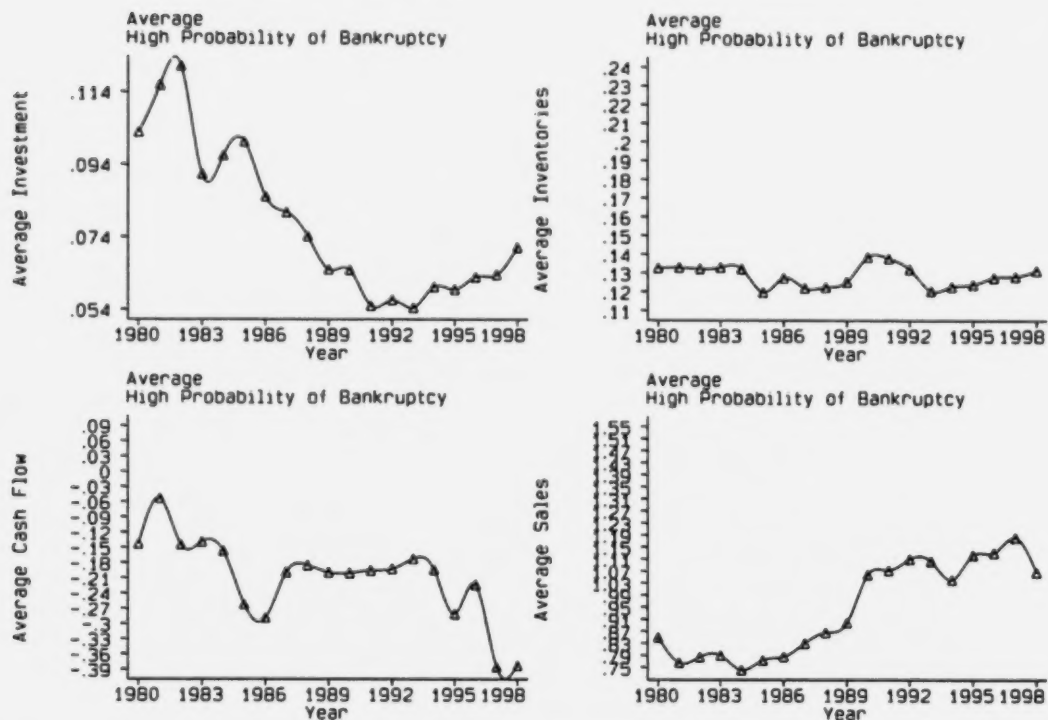
Figure A1: Healthy Firms, All Sample by Z-Score



Healthy Firms, All Sample by Z Score

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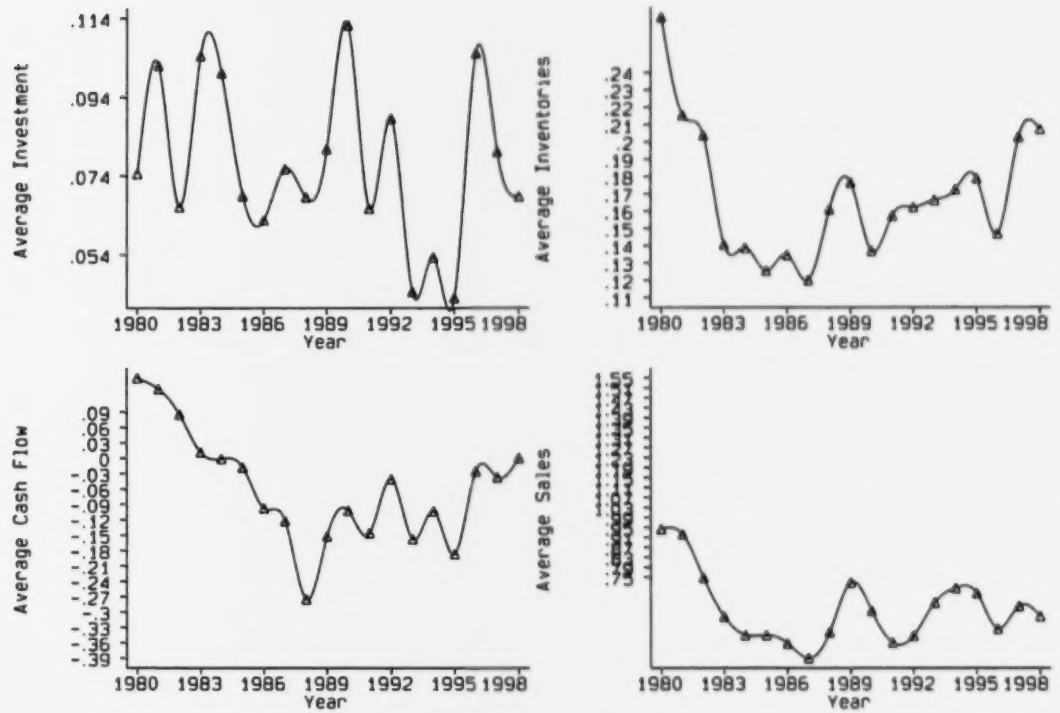
Figure A2: Troubled Firms, All Sample by Z-Score



Troubled Firms, All Sample by Z Score

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Figure A3: Set of Bankrupt Firms



Set of Bankrupt Firms

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Appendix B: About the Data from Compustat

Standard and Poor's Compustat provides a wide range of financial information about publicly traded companies in the United States and Canada. It includes financial, statistical, and market data covering more than 10,000 active firms and 9,400 inactive ones. It also includes more than 340 annual and 120 quarterly income statements, balance sheets, flows of funds, and other items. I use these data in this paper, including income-statement and balance-sheet data on North American non-financial firms, for the 1980 to 1998 period, collecting annual information on about 16,000 firms.

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